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(54) THIN BATTERY AND SEALING METHOD THEREOF

(57)Abstract:

PROBLEM TO BE SOLVED: To achieve a small, lightweight and thin battery, and improve volume energy density.

SOLUTION: A battery body structure 2 is sealed with a sealing material 8 made of a polymeric multilayer film having at least one aluminum layer 13. The sealing material 8 is formed to be cylindrical and wraps the battery body structure 2, thereby jointing an overlapped part 20. In addition, the sealing material 8 is applied so that portions corresponding to the led out side 2a and the opposite side 2c of the positive electrode material 3 and the negative electrode material 4 of the battery body structure 2 are jointed to each other at the overlapped part 20 and bent along the side.

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**CLAIMS**

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[Claim(s)]

[Claim 1]Thin battery structure which connects an electrode terminal to a positive electrode material and a negative electrode material, respectively while carrying out laminated constitution of a positive electrode material and the negative electrode material via a polymer electrolyte at least, In a thin cell which \*\*\*\*(ed) a tip of the above-mentioned electrode terminal in the state where a method of outside was made exposed, respectively, by \*\*\*\* material which consists of a polymers multilayer film which has much more aluminum layer at least, The above-mentioned \*\*\*\* material is made tubed [ which opened the cash-drawer side of the above-mentioned electrode terminal, and its opposed side wide ], wrap in the above-mentioned battery structure, and jointing treatment, such as welding, is performed to the registration part, A thin cell \*\*\*\*(ing) the above-mentioned battery structure by being inserted in along each above-mentioned side inside while jointing treatment, such as welding, is performed to a registration part in a corresponding part and a corresponding part of an opposed side of the above-mentioned electrode terminal derivation side, respectively.

[Claim 2]The thin cell according to claim 1 with which the above-mentioned \*\*\*\* object is characterized by a corresponding part with the electrode terminal cash-drawer side of the above-mentioned battery structure and an opposed side having constituted a space part of an interval of not less than 2 mm 10 mm or less among these sides, and performing junction and wrap processing.

[Claim 3]The thin cell according to claim 1 as the above-mentioned \*\*\*\* object does not project in a method of outside from both side surfaces to which these sides and a corresponding part where junction and wrap processing are performed corresponding to the electrode terminal cash-drawer side and an opposed side of the above-mentioned battery structure, respectively crosses at right angles, wherein junction and wrap processing are performed.

[Claim 4]The thin cell according to claim 1, wherein a polymer electrolyte which constitutes the above-mentioned battery structure is a gel polymer electrolyte.

[Claim 5]The thin cell according to claim 1, wherein a polymer electrolyte which

constitutes the above-mentioned battery structure is a solidification polymer electrolyte.

[Claim 6]Thin battery structure which connects an electrode terminal to a positive electrode material and a negative electrode material, respectively while carrying out laminated constitution of a positive electrode material and the negative electrode material via a gel electrolyte or a solid electrolyte at least, In a \*\*\*\* method of a thin cell of \*\*\*\*(ing) a tip of the above-mentioned electrode terminal in the state where a method of outside was made exposed, respectively, by \*\*\*\* material which consists of a polymers multilayer film which has much more aluminum layer at least, A process of opening the electrode terminal cash-drawer side and its opposed side wide, and wrapping in the above-mentioned battery structure to tubed by the above-mentioned \*\*\*\* material, A process of performing jointing treatment, such as welding, to the registration part to the above-mentioned \*\*\*\* material, A process of performing jointing treatment, such as welding, to an end on top of which a corresponding part of the above-mentioned electrode terminal cash-drawer side and its opposed side was laid to the above-mentioned \*\*\*\* object, A \*\*\*\* method of a process of inserting in a corresponding part and a corresponding part of an opposed side of the above-mentioned electrode terminal cash-drawer side to the inside along these sides to the above-mentioned \*\*\*\* object, respectively, and a thin cell \*\*\*\*(ing) the above-mentioned battery structure with the above-mentioned \*\*\*\* object through \*\*.

[Claim 7]on the above-mentioned \*\*\*\* object, a corresponding part with the electrode terminal cash-drawer side of the above-mentioned battery structure and an opposed side constitutes a space part of an interval of not less than 2 mm 10 mm or less among these sides -- junction and wrap processing -- \*\*\*\*\* -- a \*\*\*\* method of the thin cell according to claim 6 characterized by things.

[Claim 8]On the above-mentioned \*\*\*\* object, a corresponding part where junction and wrap processing are performed corresponding to the electrode terminal cash-drawer side and an opposed side of the above-mentioned battery structure, respectively, A \*\*\*\* method of the thin cell according to claim 6 as it does not project in a method of outside from both side surfaces which intersect perpendicularly with these sides, wherein junction and wrap processing are performed.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a thin cell and the \*\*\*\* methods for the same, such as a lithium ion battery which \*\*\*\* this battery structure with a sheathing material, while it laminates an electrode material and a polymer electrolyte and constitutes battery structure.

[0002]

[Description of the Prior Art] Although the cell is used widely as a power supply of a portable electronic apparatus etc., slimming down is attained with a miniaturization, a weight saving, or high capacity-ization with multi-functionalization of this portable electronic apparatus, highly-efficient-izing or a miniaturization, portable improvement, etc. For example, since it has high operating potential and the high-energy-density characteristic, the rechargeable lithium-ion battery is suitably used as a power supply of a portable electronic apparatus etc., while repetition charge is possible.

[0003] As for the conventional rechargeable lithium-ion battery, generally, the electrolysis solution is used as a conductive substance.

In order to prevent the liquid leakage of this electrolysis solution, the metal can is used as an exterior member.

Therefore, since a common rechargeable lithium-ion battery was difficult to constitute a metal can in 4 mm or less in order to hold a mechanical strength, there was a limit about slimming down.

[0004] These days, the rechargeable lithium-ion battery which used all the solid electrolytes and a gel electrolyte as an electrolyte attracts attention as an ultra thin type cell. The thin rechargeable lithium-ion battery 100 \*\*\*\* the whole with the laminate material 102, without using an inorganic or organic nonaqueous solid electrolyte and polymers gel electrolyte, constituting the battery structure 101 and using a metal can, as shown in drawing 11 and drawing 12. Since the thin rechargeable lithium-ion battery 100 does not have a liquid spill problem of an electrolysis solution and has flexibility with a thin shape, it is used as a power supply of a portable electronic apparatus etc., and is very preferred.

[0005] The thin rechargeable lithium-ion battery 100 folds up this layered product, or is wound and constituted while laminating a band-like positive electrode material and negative electrode material via SEBARETA, using all the solid electrolytes and a gel electrolyte as an electrolyte, as the battery structure 101 is mentioned above. The end

face is connected to a positive electrode material and a negative electrode material at the battery structure 101 in the positive pole terminal member 103 and the negative pole terminal member 104, respectively. While the thin rechargeable lithium-ion battery 100 wraps in the battery structure 101 with the laminate material 102 which consists of polymers multilayer film material which has the above aluminum layer further at least in a layer, the part 105 (105a thru/or 105c) which piled up this laminate material 102 -- respectively -- jointing treatment, such as hot welding and a vacuum seal, -- \*\*\*\*\* -- it \*\*\*\* by things.

[0006]As for the thin rechargeable lithium-ion battery 100, it comes to expose the positive pole terminal member 103 and the negative pole terminal member 104 by which the end face was connected to the positive electrode material and negative electrode material of the battery structure 101, respectively from the joined part 105a of the laminate material 102 in the tip. That to which the positive pole terminal member 103 and the negative pole terminal member 104 wave the metal wire to mesh shape, for example is used. The thin rechargeable lithium-ion battery 100 is using the laminate material 102 as a sheathing material, as mentioned above, is constituted by the thin shape and airtightness not only being constituted lightweight but high, and seals the battery structure 101 with high precision by performing jointing treatment with simple hot welding, vacuum seal, etc.

[0007]

[Problem(s) to be Solved by the Invention]By the way, since all the solid electrolytes and a gel electrolyte are used, dampproofing high about the laminate material 102 which seals the battery structure 101 is required, and the thin rechargeable lithium-ion battery 100 forms the joined part 105 by sufficient joining breadth. Generally the joined part 105 is set as a width of not less than 5 mm. Therefore, although the whole is constituted by the thin shape, the joined part 105 of the laminate material 102 projects to an outer peripheral part, and the thin rechargeable lithium-ion battery 100 is formed in it, as shown in drawing 11.

[0008]The thin rechargeable lithium-ion battery 100 had the problem that the efficiency of volume energy density fell by the joined part 105 of the laminate material 102 being projected and formed in an outer peripheral part, when one side was constituted by the small specification of several centimeters or less, for example. For this reason, as compared with the rechargeable lithium-ion battery which has a metal can, the thin rechargeable lithium-ion battery 100 had little increase in efficiency of a volume ratio, although a large weight saving and slimming down were attained.

[0009]As shown in drawing 12, the gap 106 of the width dimension d is formed between the peripheral part of the battery structure 101, and the laminate material 102 inside a cell, because the thin rechargeable lithium-ion battery 100 wraps the battery structure 101 which has thickness in the laminate material 102. Therefore, the thin rechargeable lithium-ion battery 100 had become the cause that volume energy density

falls further by this gap 106.

[0010]When the thin rechargeable lithium-ion battery 100 pushes the laminate material 102 strongly and \*\*\*\* it to the peripheral part of the battery structure 101, correspondence which makes the gap 106 smaller is achieved. However, crushing will produce the thin rechargeable lithium-ion battery 100 in the corner part 107 of the battery structure 101 by performing such \*\*\*\*. The problem that an electrode material and SEBARETA are damaged by this crushing, or a short circuit arises and battery capacity deteriorates between electrode materials will generate the thin rechargeable lithium-ion battery 100.

[0011]Therefore, this invention is proposed for the purpose of providing a thin cell which aimed at improvement in volume energy density, and the \*\*\*\* method for the same while attaining small size and a weight saving, and slimming down.

[0012]

[Means for Solving the Problem]A thin cell concerning this invention which attains this purpose, Thin battery structure which connects an electrode terminal to a positive electrode material and a negative electrode material, respectively while carrying out laminated constitution of a positive electrode material and the negative electrode material via a polymer electrolyte at least, A tip of an electrode terminal is \*\*\*\*(ed) in the state where a method of outside was made exposed, respectively, by \*\*\*\* material which consists of a polymers multilayer film which has much more aluminum layer at least. While \*\*\*\* material is made tubed [ which opened the cash-drawer side of an electrode terminal, and its opposed side wide ], wrapping in battery structure and performing jointing treatment, such as welding, to the registration part, a thin cell, After jointing treatment, such as welding, is performed to a registration part in a corresponding part and a corresponding part of an opposed side of the electrode terminal cash-drawer side, battery structure is \*\*\*\*(ed) by being inserted in along these sides inside, respectively.

[0013]According to the thin cell concerning this invention constituted as mentioned above, since a joined part is inserted in along the side of battery structure inside, a projection amount to a way is reduced outside a joined part of this \*\*\*\* material, volume becomes small as a whole, and while having a small light weight, improvement in volume energy density is achieved.

[0014]A \*\*\*\* method of a thin cell concerning this invention which attains the purpose mentioned above, Thin battery structure which connects an electrode terminal to a positive electrode material and a negative electrode material, respectively while carrying out laminated constitution of a positive electrode material and the negative electrode material via a polymer electrolyte at least, A tip of an electrode terminal is \*\*\*\*(ed) in the state where a method of outside was made exposed, respectively, by \*\*\*\* material which consists of a polymers multilayer film which has much more aluminum layer at least. A process to which a \*\*\*\* method of a thin cell opens the

electrode terminal cash-drawer side and its opposed side wide, and wraps battery structure in \*\*\*\* material to tubed, A process of performing jointing treatment, such as welding, to the registration part to \*\*\*\* material, and a process of performing jointing treatment, such as welding, to a registration part of a corresponding part and a corresponding part of an opposed side of the electrode terminal derivation side to a \*\*\*\* object, A process inserted in to the inside over a corresponding part and an opposed side of the electrode terminal derivation side to a \*\*\*\* object is given, and battery structure is \*\*\*\*(ed) with a \*\*\*\* object.

[0015]From according to a \*\*\*\* method of a thin cell concerning this invention which passes through the above process, inserting in a joined part of a \*\*\*\* object to the inside along the side of battery structure, and \*\*\*\*(ing) battery structure with a \*\*\*\* object. A projection amount to a way is reduced outside a joined part of this \*\*\*\* material, the whole volume becomes small, and while having a small light weight, a thin cell with which improvement in volume energy density was achieved is obtained.

[0016]

[Embodiment of the Invention]Hereafter, an embodiment of the invention is described in detail with reference to drawings. The thin cell shown in drawing 1 and drawing 2 as an embodiment of the invention, While laminating the band-like positive electrode material 3 and the negative electrode material 4 via SEBARETA 5 and a polymer electrolyte, connect the positive pole terminal member 6 and the negative pole terminal member 7 to the positive electrode material 3 and the negative electrode material 4, respectively, and the battery structure 2 is constituted, This battery structure 2 is \*\*\*\*(ed) with the laminate material 8, and the rechargeable lithium-ion battery 1 which can be charged is shown. This invention is not what is limited to this rechargeable lithium-ion battery 1, Of course, it is applied to other thin cells, for example, the polymer battery etc. with which charge put SEBARETA which consists of polymer electrolysis material of film state between an impossible lithium ion battery and positive electrode material, and the negative electrode material, and constituted the layered product.

[0017]The rechargeable lithium-ion battery 1 makes fundamental composition be the same as that of the conventional rechargeable lithium-ion battery, and the positive electrode material 2 carries out membrane formation formation of the positive active material in which the insertion desorption from a positive ion is possible on the surface of the positive pole collector of the film state of aluminium foil etc. A lithium nickel oxide ( $\text{LiNiO}_2$ ), a lithium cobalt oxide ( $\text{LiCoO}_2$ ), or a lithium manganic acid ghost ( $\text{LiMn}_2\text{O}_4$ ) is used for positive active material, for example. A transition metal element is not limited to one kind, for example, it is [ transition metal element ] usable also in two or more kinds of things like  $\text{LiNi}_{0.5}\text{CO}_{0.5}\text{O}_2$ .

[0018]Positive active material as a conducting material to the material mentioned above A carbon material, Polyvinylidene fluoride (PVdF) is mixed as a binder, and n-methyl

pyrrolidone (NMP) is added as a solvent, and it is made slurry form, and is uniformly applied on the aluminium foil of a positive pole collector using the Dr. Praed method. By performing the drying process in an elevated temperature, NMP is flown and membrane formation formation of the positive active material is uniformly carried out on aluminium foil. Positive active material should just be made into the slurry form which the mixture distributed uniformly, and is not limited for the mixing ratio. By performing pressure treatment by a roll press, on the surface of a positive pole collector, densification is attained and membrane formation formation of the positive active material is carried out.

[0019]The negative electrode material 3 carries out membrane formation formation of the negative electrode active material in which the insertion desorption from lithium is possible, for example on the negative pole collector of film state, such as copper foil. It is not limited to the phenomenon of taking lithium in and out within a crystal structure as insertion desorption of lithium is possible, but when constituted as a cell, charge and discharge should just be made possible, for example, a lithium metal negative electrode, a lithium aluminum alloy negative electrode, etc. are mentioned.

[0020]As for negative electrode active material, carbon materials, such as graphite, difficulty graphitized carbon, and easily graphitized carbon, are used, for example. To this carbon material, negative electrode active material mixes PVdF as a binder, adds NMP as a solvent, makes it slurry form, and is uniformly applied on copper foil using the Dr. Praed method. By performing the drying process in an elevated temperature, NMP is flown and membrane formation formation of the negative electrode active material is uniformly carried out on copper foil. What is necessary is to just be considered as the slurry form which the mixture distributed uniformly also with negative electrode active material, and it is not limited for the mixing ratio. By performing pressure treatment by a roll press, on the surface of a negative pole collector, densification is attained and membrane formation formation of the negative electrode active material is carried out.

[0021]As for SEBARETA 5, a porous polypropylene film is used, for example. About SEBARETA 5, the film made of other polyolefin system polymer resin may be used.

[0022]As for an electrolyte, a gel electrolyte and a solid electrolyte are used. as for a gel electrolyte, a polymer material, an electrolysis solution, and electrolyte salt are mixed -- gel ---izing is come. What is dissolved in an electrolysis solution is used for a polymer material, for example, polyacrylonitrile (PAN), polyether system polymers, PVdF, styrene butadiene rubber (SBR), etc. are mentioned to it. A gel electrolyte does not have restriction of the amount of electrolysis solutions which the electrolysis solution is distributed, and is \*\*\*\*ed and distributed in the polymers matrix.

[0023]Suppose that distribution of a polymer material is possible for an electrolysis solution, and as an aprotic solvent, for example Ethylene carbonate (EC), Propylene carbonate (PC), butylene carbonate (BC), a gamma butyrolactone (GBL), ethyl methyl

carbonate (EMC), dimethyl carbonate (DMC), dimethoxyethane (DME), etc. are mentioned. Not only one kind but two kinds or more may be mixed and used for a solvent.

[0024]A solid electrolyte is an electrolyte which does not contain a solvent component in an electrolyte, or an electrolyte which a liquid spill does not produce even if contained, and there is no restriction in particular in the construction material. What is dissolved to the solvent mentioned above is used for electrolyte salt, and it comes to combine a cation and an anion with it. An alkaline metal and alkaline-earth metals are used for a cation. Cl, Br, I, SCN, ClO<sub>4</sub>, BF<sub>4</sub>, PF<sub>6</sub>, CF<sub>3</sub>SO<sub>3</sub>, 2<sup>(CF<sub>3</sub>SO<sub>3</sub>)</sup>, etc. are used for an anion. Lithium hexafluorophosphate, tetrafluoride lithium borate, etc. are mentioned, and if it is the concentration which can be dissolved in an electrolysis solution, there will be no problem in particular in electrolyte salt.

[0025]Although what wove the metal conductor to mesh shape is used, if they may be a metallic foil, a lead, etc., for example, and the positive pole terminal member 6 and the negative pole terminal member 7 are a material in which electrical continuity is planned while they are electrochemically and chemically stable, they will not be limited to metal. That by which the lead of the narrow diameter which consists of aluminum or nickel, for example was woven at mesh shape is used for the positive pole terminal member 6. That by which the lead of the narrow diameter which consists of copper or nickel, for example was woven at mesh shape is used for the negative pole terminal member 7.

[0026]The positive pole terminal member 6 and the negative pole terminal member 7 are presenting the whole rectangle, and the end part is connected to the positive electrode material 3 and the negative electrode material 4 by ultrasonic welding or spot welding, respectively. When \*\*\*\*(ing) battery structure 2 with the laminate material 8 so that the positive pole terminal member 6 and the negative pole terminal member 7 may be mentioned later, as shown in drawing 1, a tip part is exposed to the method of outside, respectively. From the same side 2a of the battery structure 2, it projects and the positive pole terminal member 6 and the negative pole terminal member 7 are exposed, as shown in the figure in this case, but they project and it may be made to make them expose from which direction, on condition that a short circuit etc. are not produced mutually and battery capacity is not affected again. The positive pole terminal member 6 and the negative pole terminal member 7 do not produce a short circuit etc. mutually, and it may be made to connect them to a proper connection method and connected part to the positive electrode material 3 and the negative electrode material 4, on condition that an electrical link is held certainly.

[0027]A gel electrolyte is applied to the principal surface which faces, and the positive electrode material 3 mentioned above and the negative electrode material 4 are suitably laminated on both sides of SEBARETA 5. Via SEBARETA 5, the interval and pressure are held uniformly, are unified by adhesion operation of a gel electrolyte, and the positive electrode material 3 and the negative electrode material 4 constitute the layered

product 9. As shown, for example in drawing 3, the winding path of the positive electrode material 3, the negative electrode material 4, and the layered product 9 of SEBARETA 5 is carried out to multistage, and they constitute the battery structure 2 of a predetermined size. The outermost layer of the layered product 9 of the battery structure 2 may be any of the positive electrode material 3 or the negative electrode material 4 in this case. As for the battery structure 2, although the positive pole terminal member 6 and the negative pole terminal member 7 connect with the bottom of the heap of the layered product 9 and are constituted in the figure, it is needless to say that it may connect with which layer and may constitute as mentioned above.

[0028]The layered product 9 may constitute the battery structure 2 which has a predetermined outer diameter by being spirally wound around two or more layers, as shown, for example in drawing 4. The outermost periphery layers of the layered product 9 of the battery structure 2 may be any of the positive electrode material 3 or the negative electrode material 4 also in this case.

[0029]The layered product 9 constitutes the battery structure 2 by laminating two or more positive electrode materials 3 and negative electrode materials 4 which were beforehand cut out by the predetermined size as shown in drawing 5 on both sides of SEBARETA 5. SEBARETA 5 is judged by slightly larger contour shape to the positive electrode material 3 and the negative electrode material 4, and has prevented the short circuit of the positive electrode material 3 and the negative electrode material 4 in the state where it laminated. It comes to connect each positive electrode material 3 and each negative electrode material 4 mutually via the contact buttons 10 and 11. The outermost periphery layers of the layered product 9 of the battery structure 2 may be any of the positive electrode material 3 or the negative electrode material 4 also in this case. It may be made to constitute the battery structure 2 in a proper size and shape by methods other than the method which mentioned above the positive electrode material 3, the negative electrode material 4, and the layered product 9 of SEBARETA 5.

[0030]The moistureproof multilayer film material which contains the aluminum layer of one layer and a polymer resin layer in a layer at least is used for the laminate material 8. It is constituted by four layer systems of the polyethylene terephthalate layer (PET layer) 12 of the 1st layer, the aluminum layer 13 of the 2nd layer, the PET layer 14 of the 3rd layer, and the unextended polypropylene layers (CPP layer) 15 of the 4th layer, and the laminate material 8 becomes, as shown, for example in drawing 6. The layer [ 1st ] PET layer 12 constitutes an armoring part, and it does an insulating operation so while it protects the aluminum layer 13. The aluminum layer 13 of the 2nd layer does a better water proof operation so. The layer [ 3rd ] PET layer 14 also does so the protective action of the aluminum layer 13.

[0031]The laminate material 8 carries out the layer [ 4th ] CPP layer 15 inside, and it wraps in the battery structure 2 so that details may be mentioned later. The laminate material 8 acts as a thermal melting arrival poly membrane on the occasion of the

jointing treatment which this CPP layer 15 mentions later. This CPP layer 15 holds firmly these positive pole terminal member 6 and the negative pole terminal member 7 in a cash-drawer part by melting in each meshes of a net of the pulled-out positive pole terminal member 6 and the negative pole terminal member 7, when thermal melting arrival of the laminate material 8 is carried out mutually.

[0032]The laminate material 8 is not limited to the composition mentioned above, and while having the aluminum layer 13 of one layer in a layer, the polymer resin layer which acts as a thermal melting arrival poly membrane should just be formed in one of surface and rear surfaces. The laminate material 8 carries out a polymer resin layer inside, and wraps in the battery structure 2.

[0033]The \*\*\*\* process of the battery structure 2 by the laminate material 8 mentioned above is explained below with reference to drawing 7 thru/or drawing 10. Laminated constitution of the battery structure 2 is carried out, for example to a rectangle, and the positive pole terminal member 6 and the negative pole terminal member 7 are projected by the one side face 2a of the longitudinal direction, respectively. What the laminate material 8 presents the rectangle which has mist and a big outside dimension from the extend dimension of the battery structure 2 is used. As the laminate material 8 is shown in drawing 7, while the tip parts 8a and 8b of each other are piled up in one principal surface 2b of the battery structure 2, hot welding processing or vacuum pressure arrival processing is performed to this registration part 20. As for the laminate material 8, it is preferred to carry out the layer [ 1st ] PET layer 12 mentioned above the surface side, and to wrap in the battery structure 2.

[0034]The laminate material 8 imitates the peripheral face of the battery structure 2 which contains principal surface 2b as shown in drawing 8 in this case, and is bent in the shape of an rectangular pipe. the registration part 20 which the laminate material 8 mentioned above -- if it puts in another way, as the 1st joined part 20 shows by the figure arrow, it will be bent along with principal surface 2b of the battery structure 2. The tubed parts 21 and 22 where the laminate material 8 projects, respectively from the both side surfaces 2a and 2c of the longitudinal direction of the battery structure 2 are formed. The laminate material 8 piles up mutually a tip part (8c, 8d) and (8e, 8f), respectively, and hot welding processing or vacuum pressure arrival processing is performed to these registration parts 23 and 24. These cylindrical parts 21 and 22 where the laminate material 8 had the tip part joined are inserted in inside over the both side surfaces 2a and 2c of the battery structure 2, respectively.

[0035]According to the crest folding line L1 which the fields 21a and 21b parallel to the sides 2d and 2e of the battery structure 2 show to drawing 9 with a dashed line along with edges on both sides, crest folding of the cylindrical part 21 of one side of the laminate material 8 is carried out to the one side face 2a side of a longitudinal direction, respectively. The parallel areas 21a and 21b are inserted in along the side 2a according to the 1st and 2nd valley folding lines L2 and L3 which constitute the isosceles triangle

which makes the crest folding line L1 a base as the drawing 2 dotted line shows further, and these valley folding lines L2 and the 3rd level valley folding line L4 that goes to the tip side from L3. it projects from the side 2a and the positive pole terminal member 6 and the negative pole terminal member 7 which were carried out are shown in drawing 10 -- as -- the registration part 23 -- if it puts in another way, from the 2nd joined part 23, it will project to the method of outside and will be exposed.

[0036]Similarly, according to the crest folding line L5 which the fields 22a and 22b parallel to the sides 2d and 2e of the battery structure 2 show to drawing 9 with a dashed line along with edges on both sides, crest folding of the cylindrical part 22 of the other side of the laminate material 8 is carried out to the one side face 2c side of a longitudinal direction, respectively. The parallel areas 22a and 22b are inserted in along the side 2a according to the 1st which constitutes the isosceles triangle which makes the crest folding line L5 a base as the drawing 2 dotted line shows further and 2nd valley folding line L6, L7, and these valley folding line L6 and the 3rd level valley folding line L8 that goes to the tip side from L7.

[0037]The laminate material 8 comes to \*\*\*\* battery structure 2 through the process which the rechargeable lithium-ion battery 1 mentioned above. The 1st joined part 20 corresponding to principal surface 2b of the battery structure 2 of the laminate material 8 in the rechargeable lithium-ion battery 1, It is constituted without the 2nd joined part 23 corresponding to the side 2a in which the positive pole terminal member 6 and the negative pole terminal member 7 are exposed, and the 3rd joined part 24 corresponding to the side 2a and the side 2c which counters projecting greatly from the battery structure 2, as shown in drawing 2. The rechargeable lithium-ion battery 1 is constituted without hardly projecting the joined part of the laminate material 8, as the part corresponding to the both side surfaces 2d and 2e of the battery structure 2 is shown in drawing 1.

[0038]By the way, in the rechargeable lithium-ion battery 1, that by which the positive pole terminal member 6 and the negative pole terminal member 7 were made larger than the depth size of the CPP layer 15 of the laminate material 8 in the depth size may be used. As mentioned above, the rechargeable lithium-ion battery 1 performs thermo-compression-bonding processing etc. to the laminate material 8, and \*\*\*\* the cash-drawer part of the positive pole terminal member 6 and the negative pole terminal member 7 in the 2nd joined part 23, but the state where sufficient \*\*\*\* processing cannot be performed produces it.

[0039]Therefore, in the rechargeable lithium-ion battery 1, as shown in drawing 10, the high polymer resin films 30 and 31 are inserted between the positive pole terminal member 6 and the negative pole terminal member 7, and the laminate material 8. The film material which consists of polyethylene and its polymer, for example, ionomer resin, ethylene acrylic acid copolymer resin, or ethylene methacrylic acid copolymer resin is used for these high polymer resin films 30 and 31. By performing

thermo-compression-bonding processing etc. to the laminate material 8, the high polymer resin films 30 and 31 melt into the positive pole terminal member 6 and the negative pole terminal member 7, and \*\*\*\* certainly the cash-drawer part in the 2nd joined part 23.

[0040]By the way, in the rechargeable lithium-ion battery 1, between the both side surfaces 2a and 2c of the longitudinal direction of the battery structure 2, and the 2nd joined part 23 of the laminate material 8 and the 3rd joined part 24 corresponding to these, as shown in drawing 2, the gaps 25 and 26 are formed, respectively. These gaps 25 and 26 are inevitably produced by performing insertion operation mentioned above as did not crush the edge part of the battery structure 2 which \*\*\*\*(ed). As the maximum width dimensions delta x and delta y of these gaps 25 and 26 carry out the rechargeable lithium-ion battery 1 not less than 2 mm 10 mm or less, respectively, battery structure 2 is \*\*\*\*(ed) by the laminate material 8. The gaps 25 and 26 are inevitably set to not less than 2 mm, when the laminate material 8 is inserted in and operated. When exceeding 10 mm, it becomes impossible for the gaps 25 and 26 to aim at improvement in volume energy density.

[0041]By constituting the rechargeable lithium-ion battery 1 as mentioned above, the projection amount of each joined parts 20, 23, and 24 of the laminate material 8 which \*\*\*\* battery structure 2 is reduced, and the whole size is constituted almost on a par with the battery structure 2. The rechargeable lithium-ion battery 1 is constituted so that the gap constituted between the battery structure 2 and the laminate material 8 may be made into the minimum in the range which does not spoil battery capacity. Therefore, as for the rechargeable lithium-ion battery 1, while the miniaturization is attained, improvement in volume energy density is achieved.

[0042]About the significance of the rechargeable lithium-ion battery 1 mentioned above, the 1st example thin cell 1A of specification thru/or the 3rd example thin cell 1C explained below, the 1st comparative example thin cell 100A, or the 3rd comparative example thin cell 100C was manufactured, and each volume comparison was performed.

[0043]Namely, the 1st example thin cell 1A formed the positive pole terminal member 6 and the negative pole terminal member 7 in the following positive electrode materials 3 by specification, negative electrode materials 4, SEBARETA 5, and gel electrolytes, constituted the battery structure 2, by the method which mentioned this battery structure 2 above, was \*\*\*\*(ed) with the laminate material 8 and constituted it. While black lead is mixed and it mixes PVdF for LiCoO<sub>2</sub> at 3% of the weight of a rate 6% of the weight 91% of the weight, the positive electrode material 3, On the other hand, it manufactured by drying it at an elevated temperature, while applying uniformly to one side of aluminium foil the positive active material which adds one 0.6 time the quantity of this, and becomes as slurry form about NMP by the Dr. Praed method, and flying NMP. The positive electrode material 3 performed the press process, having put the suitable pressure for positive active material using the roll press.

[0044]While the negative electrode material 4 mixes graphite and mixes PVdF at 9% of the weight of a rate 91% of the weight, On the other hand, it manufactured by drying it at an elevated temperature, while applying uniformly to one side of copper foil the negative electrode active material which adds one 1.1 times the quantity of this, and becomes as slurry form about NMP by the Dr. Praed method, and flying NMP. The negative electrode material 4 performed the press process, having put the suitable pressure for negative electrode active material using the roll press.

[0045]The positive electrode material 3 mentioned above was cut off to 390 mm x 65 mm, carried out spot welding of the end part of the positive pole terminal member 6 which wove and formed the wire of aluminium in mesh shape, and connected. The negative electrode material 4 was cut off to 400 mm x 70 mm, carried out spot welding of the negative pole terminal member 7 which wove and formed copper wire in mesh shape, and connected.

[0046]a gel electrolyte -- 12-mol EC manufactures PC at 44-mol %%, it is manufactured at 22-mol %, and 15-mol % and LiPF<sub>6</sub> is manufactured [ PAN ] for GBL at 7-mol% of a rate. The process with which a gel electrolyte mixes PAN, PC, and GBL, and the process agitated until it adds PAN to this and becomes a homogeneous solution by 100 degreeC on a hot stirrer, It is manufactured through the process agitated until it adds LiPF<sub>6</sub> and becomes a homogeneous solution by 80 degreeC after checking that these have become uniform. A liquefied state is held without gel-izing a gel electrolyte under an 80 degreeC condition.

[0047]After being uniformly applied to each electrode material spreading side of the positive electrode material 3 and the negative electrode material 4 which were mentioned above where a gel electrolyte is held liquefied, SEBARETA 5 is put and a part for a surplus is extruded. The positive electrode material 3, the negative electrode material 4, and the layered product of SEBARETA 5 are folded up by the 36mmx70mmx5mm size, and constitute the battery structure 2. The 1st example thin cell 1A \*\*\*\*(ed) and constituted this battery structure 2 by the method mentioned above using the 150-micrometer-thick laminate material 8. The volume of this 1st example thin cell 1A was 14.8-cm<sup>2</sup>.

[0048]It was manufactured by the manufacturing method of the 1st example thin cell 1A that mentioned others above, and the same method, using hard carbon as negative electrode active material while LiNiO<sub>2</sub> was used for the 2nd example thin cell 1B as positive active material. The volume of this 2nd example thin cell 1B was 14.9-cm<sup>2</sup>.

[0049]It was manufactured by the manufacturing method of the 1st example thin cell 1A that mentioned others above, and the same method, using hard carbon as negative electrode active material while LiMn<sub>2</sub>O<sub>4</sub> was used for the 3rd example thin cell 1C as positive active material. The volume of this 3rd example thin cell 1C was 14.9-cm<sup>2</sup>.

[0050]It manufactured battery structure by the manufacturing method of the 1st example thin cell 1A that mentioned others above, and the same method, using graphite

as negative electrode active material while LiCoO<sub>2</sub> was used for the 1st comparative example thin cell 100A as positive active material. The 1st comparative example thin cell 100A was \*\*\*\*(ed) using the 150-micrometer-thick laminate material 8 by the same method as the conventional thin cell 100 which mentioned this battery structure above. The volume of this 1st comparative example thin cell 100A was 17.0-cm<sup>2</sup>.

[0051]It manufactured battery structure by the manufacturing method of the 1st example thin cell 1A that mentioned others above, and the same method, using hard carbon as negative electrode active material while LiNiO<sub>2</sub> was used for the 2nd comparative example thin cell 100B as positive active material. The 2nd comparative example thin cell 100B was \*\*\*\*(ed) using the 150-micrometer-thick laminate material 8 by the same method as the conventional thin cell 100 which mentioned this battery structure above. The volume of this 2nd comparative example thin cell 100B was 16.9-cm<sup>2</sup>.

[0052]It manufactured battery structure by the manufacturing method of the 1st example thin cell 1A that mentioned others above, and the same method, using hard carbon as negative electrode active material while LiMn<sub>2</sub>O<sub>4</sub> was used for the 3rd comparative example thin cell 100C as positive active material. The 3rd comparative example thin cell 100C was \*\*\*\*(ed) using the 150-micrometer-thick laminate material 8 by the same method as the conventional thin cell 100 which mentioned this battery structure above. The volume of this 3rd comparative example thin cell 100C was 17.2-cm<sup>2</sup>.

[0053]As mentioned above, to the 1st comparative example thin cell 100A, the volume is small about 15%, and the 1st example thin cell 1A is constituted. As compared with the 2nd comparative example thin cell 100B, the volume is small constituted by the 2nd example thin cell 1B about 13%. As compared with the 3rd comparative example thin cell 100C, the volume is small about 15%, and the 3rd example thin cell 1C is constituted. Thus, the 1st example thin cell 1A thru/or the 3rd example thin cell 1C receive the 1st comparative example thin cell 100A thru/or the 3rd comparative example thin cell 100C manufactured similarly, and since the volume is small constituted also for a gap, improvement in volume energy density is achieved.

[0054]

[Effect of the Invention]From having inserted in and constituted the joined part of the \*\*\*\* object which \*\*\*\* battery structure along the side of battery structure according to the thin cell concerning this invention, as explained to details above. It becomes possible to reduce the projection amount to a way outside the joined part of this \*\*\*\* material, and to constitute the whole volume small, and while having a small light weight, improvement in volume energy density is achieved and it is used suitably for a portable electronic apparatus etc.

[0055]The process of according to the \*\*\*\* method of the thin cell concerning this invention opening the electrode terminal cash-drawer side and its opposed side wide,

and wrapping battery structure in \*\*\*\* material to tubed, The process of performing jointing treatment, such as welding, to the registration part to \*\*\*\* material, and the process of performing jointing treatment, such as welding, to the end on top of which the corresponding part of the electrode terminal cash-drawer side and its opposed side was laid to the \*\*\*\* object, From it having been made to \*\*\*\* battery structure with a \*\*\*\* object through the process of inserting in the corresponding part and the corresponding part of an opposed side of the electrode terminal cash-drawer side to the inside along these sides to a \*\*\*\* object, respectively. The projection amount to a way is reduced outside the joined part of \*\*\*\* material, the whole volume is constituted small, and while having a small light weight, the thin cell which improvement in volume energy density is achieved and is used suitably for a portable electronic apparatus etc. is manufactured.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1]It is a perspective view of the rechargeable lithium-ion battery shown as an embodiment of the thin cell concerning this invention.

[Drawing 2]It is a figure explaining the outline composition of the rechargeable lithium-ion battery.

[Drawing 3]It is a composition explanatory view of the battery structure with which the rechargeable lithium-ion battery is equipped.

[Drawing 4]It is a composition explanatory view of other battery structure with which the rechargeable lithium-ion battery is equipped.

[Drawing 5]It is a composition explanatory view of other battery structure with which the rechargeable lithium-ion battery is equipped.

[Drawing 6]It is a composition explanatory view of the laminate material which \*\*\*\* battery structure with which the rechargeable lithium-ion battery is equipped.

[Drawing 7]It is an explanatory view of the \*\*\*\* process of the battery structure by a laminate material, and is an explanatory view of the process of joining the registration part of a laminate material.

[Drawing 8]It is an explanatory view of enclosed \*\*\*\*\* and is an explanatory view of the process which folds up the registration part of a laminate material and is made into the shape of an rectangular pipe.

[Drawing 9]It is an explanatory view of enclosed \*\*\*\*\* and is an explanatory view of the process of inserting in a laminate material along the side of battery structure.

[Drawing 10]It is a composition explanatory view of the drawer part of other terminal members.

[Drawing 11]It is a perspective view of the conventional thin cell.

[Drawing 12]It is a partial notch important section perspective view of the thin cell.

[Description of Notations]

1 A rechargeable lithium-ion battery (thin cell) and 2 Battery structure and 3 Positive electrode material, Four negative electrode materials and 5 [ The 1st joined part and 21 / A cylindrical part and 22 / A cylindrical part and 23 / The 2nd joined part and 24 / The 3rd joined part ] SEBARETA and 6 A positive pole terminal member and 7 A negative pole terminal member, 8 laminate materials, 12 PET layer, 13 aluminum layers, 14 PET layer, 15 CPP layer, and 20